

Biology 30

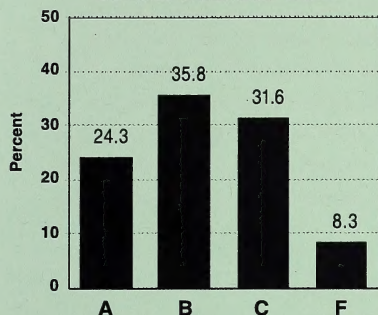
Diploma Examination Results

Examiners' Report for June 1994

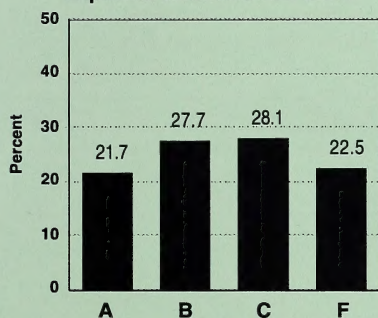
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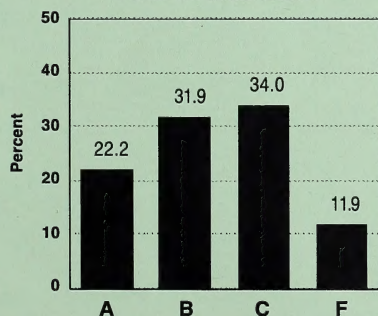
School-Awarded Mark



Diploma Examination Mark



Final Course Mark



The summary information in this report provides teachers, school administrators, students, and the general public with an overview of results from the June 1994 administration of the Biology 30 Diploma Examination. This information is most helpful when used with the detailed school and jurisdiction reports that have been mailed to schools and school jurisdiction offices. An annual provincial report containing a detailed analysis of the combined January, June, and August results is published each year.

Description of the Examination

The Biology 30 Diploma Examination consists of two parts: a multiple-choice section of 70 questions worth 70% and a written-response section of four questions worth 30% of the total examination mark.

Achievement of Standards

The information reported is based on the final course marks achieved by 9 513 students in Alberta who wrote the June 1994 examination. This represents a decrease of 2 537 students compared to June 1993. The decrease is partially accounted for by the fact that 1 164 students received final course marks in the revised (pilot) Biology 30 course. Since these pilot students did not write the June 1994 diploma examination, the information in this report does not include them.

- 88.1% of the 9 513 students achieved the acceptable standard (a final course mark of 50% or higher).
- 22.2% of these students achieved the standard of excellence (a final course mark of 80% or higher).

Generally, student achievement in Biology 30 was good. Compared to June 1993, there was a small decrease (88.8 to 88.1) in the percentage of students who achieved the acceptable standard. Most students demonstrated a good understanding of cellular processes and the function of human organ systems. Many students demonstrated the ability to make meaningful connections between concepts of human physiology and technology. Some students had difficulty forming hypotheses and identifying manipulated variables that related to experimental data.

Approximately 58.7% of the students who wrote the examination were female. Approximately 75.1% of this female population achieved the acceptable standard on the examination, compared to 80.3% of the male population.

Provincial Averages

- The average school-awarded mark was 68.0%.
- The average diploma examination mark was 63.7%.
- The average final course mark, representing an equal weighting of the school-awarded mark and the diploma examination mark, was 66.2%.

Approximately 13.3% of the students who wrote the examination in June 1994 and received a school-awarded mark had written at least one other Biology 30 Diploma Examination during the January 1993 to January 1994 period. This subpopulation (1 265) achieved an examination average of 57.4%, compared to 64.6% for the population (8 248) whose first writing of a Biology 30 examination was in June 1994. However, the group of students who rewrote (1 265) increased their examination average score from 50.5% to 57.4%.

Results and Examiners' Comments

Subtest: Machine Scored

When analyzing detailed examination results, please bear in mind that subtest results **cannot** be directly compared.

Results are in average raw scores.

Machine Scored: 46.3 out of 70

Course Content

- Cellular Processes: 5.3 out of 8
- Homeostatic Mechanisms: 2.2 out of 3
- Nutrition and Digestion: 10.6 out of 16
- Body Fluids: 4.4 out of 6
- Breathing, Gas Exchange, and Transport: 2.0 out of 3
- Energy Release: 2.5 out of 4
- The Kidney: 6.7 out of 10
- Regulation of the Internal Environment: 8.1 out of 13
- Voluntary Movement and Body Support: 2.0 out of 3
- Human Reproduction: 2.6 out of 4

Process Skills: 11.7 out of 18

- Multiple-choice questions 5, 6, 11, 16, 20, 21, 22, 23, 24, 25, 26, 39, 40, 46, 50, 61, 62, and 66.

Cognitive Levels

- Knowledge: 17.4 out of 25
- Comprehension and Application: 21.7 out of 33
- Higher Mental Activities: 7.2 out of 12

Machine-Scored Blueprint (Multiple Choice)

Each question in this section is classified in two ways: according to the curricular content area being tested and according to the cognitive level demanded by the question. The examination blueprint illustrates the distribution of questions in June 1994 according to these classifications.

Course Content	Machine Scored			Examination Emphasis (%)
	Knowledge	Comprehension and Application	Higher Mental Activities	
Cellular Processes	1, 2	3, 4, 6, 7, 8	5	8
Homeostatic Mechanisms	9	10	11	3
Nutrition and Digestion	12, 13, 14, 15	16, 17, 18, 19, 20, 21, 23, 25, 26	22, 24, 27	16
Body Fluids	28, 29, 30, 31	32, 33		6
Breathing, Gas Exchange, and Transport	34, 35		36	3
Energy Release	37	38	39, 40	4
The Kidney	41, 42, 45	43, 44, 47, 48, 49, 50	46	10
Regulation of the Internal Environment	51, 52, 53, 54, 55	56, 57, 58, 59, 60, 61, 62	63	13
Voluntary Movement and Body Support	64	65, 66		3
Human Reproduction	67, 68		69, 70	4
Examination Emphasis (%)	25	33	12	70

Subtest: Teacher Scored

Results are in average raw scores.

Teacher Scored: 17.3 out of 30

Written-Response Questions

- Question 1: 6.2 out of 10
- Question 2: 3.4 out of 6
- Question 3: 2.3 out of 4
- Question 4: 5.5 out of 10

Teacher-Scored Blueprint (Written Response)

Each question in this section is designed to measure student achievement of two or more course objectives. Furthermore, students are expected to use a variety of cognitive skills to construct satisfactory responses. The examination blueprint illustrates the distribution of questions in June 1994 according to these classifications.

Question Number	Teacher Scored	Examination Emphasis (%)
	Question Description (Concept, Cognitive Levels, and Process Skills)	
1	Explaining symptoms of hypothermia. Identifying methods for inducing and monitoring hypothermia. Communicating clearly and logically.	10
2	Describing reproductive functions and identifying appropriate technologies.	6
3	Explaining uses, advantages, and disadvantages of a drug used to prevent heart attacks and strokes in humans.	4
4	Forming hypotheses, identifying variables, forming and evaluating conclusions, making science and social connections.	10
Examination Emphasis (%)		30

Multiple Choice

Question	Key	Difficulty*	Question	Key	Difficulty*
1	B	69.1	36	D	55.3
2	B	76.0	37	B	70.0
3	C	68.9	38	D	55.4
4	A	57.1	39	D	62.0
5	D	54.4	40	C	65.9
6	B	69.3	41	A	78.1
7	D	61.2	42	A	74.3
8	A	78.1	43	C	74.4
9	A	75.7	44	C	56.0
10	D	72.6	45	D	68.3
11	B	70.0	46	B	53.5
12	D	55.7	47	A	67.8
13	A	63.8	48	A	53.5
14	A	50.7	49	D	66.7
15	B	83.1	50	C	77.6
16	D	72.5	51	B	74.9
17	A	61.0	52	B	64.9
18	D	66.0	53	C	72.2
19	B	58.6	54	B	62.7
20	C	53.8	55	A	61.0
21	B	76.7	56	D	74.5
22	C	72.8	57	B	78.5
23	A	88.2	58	D	67.0
24	D	62.1	59	A	49.7
25	D	58.8	60	A	48.9
26	B	66.9	61	A	51.7
27	D	64.9	62	C	55.8
28	A	68.0	63	B	44.8
29	D	68.7	64	C	65.3
30	C	70.4	65	D	78.6
31	C	76.2	66	C	54.9
32	D	72.6	67	D	77.5
33	C	79.8	68	C	70.0
34	C	77.7	69	B	51.7
35	D	69.0	70	C	59.1

*Difficulty—percentage of students answering the question correctly

This examination has a balance of question types and difficulties. It is designed so that students capable of achieving the acceptable standard will obtain a mark of 50% or higher and students capable of achieving the standard of excellence will obtain a mark of 80% or higher. This examination is parallel in structure to the Biology 30 January 1994 Diploma Examination and to the 1993 Biology 30 diploma examinations.

Machine-Scored Section (Multiple-Choice Questions)

For a complete breakdown of student responses by alternative for the multiple-choice questions, please refer to the school and jurisdiction reports.

Most students who achieved the acceptable standard interpreted experimental data that was presented in diagrams, simple graphs, or tables (questions 6, 21–23, and 26). They sequentially ordered the major steps of physiological processes (questions 54, 55, and 67). They related physiological concepts to common everyday experiences (questions 51 and 53). They understood basic functions of human body structures, as assessed by many questions, but they did not know the properties of some key biological substances (questions 12, 25, and 69).

**Percentage of Students Correctly Answering
Selected Machine-Scored Questions**

Student Group	Question Number				
	5	51	59	69	70
All students	54.4	74.9	49.7	51.7	59.1
A (80% or higher)	89.4	94.8	77.5	80.5	88.0
C (50% to 64%)	40.9	72.4	37.8	40.1	50.7
F (less than 50%)	25.6	47.1	29.7	28.8	31.3

Use the following information to answer question 5.

The Function of Mitochondria

A scientist hypothesized that mitochondria release energy from glucose when oxygen is present. In order to verify this hypothesis, the scientist conducted an experiment. Two identical muscle cells were taken from a cell culture. The scientist removed all the mitochondria from one of the cells. The cells were then placed in separate solutions containing glucose and other essential nutrients. The chemical activity of the cells was monitored.

5. Monitoring which processes would help the scientist to verify the hypothesis?
- A. ATP consumption and O₂ production
 - B. CO₂ consumption and ATP production
 - C. O₂ consumption and glucose production
 - D. Glucose consumption and CO₂ production
51. When a person eats a candy bar that has a high sugar content, under normal conditions the pancreas secretes
- A. insulin, thereby increasing the blood sugar levels
 - B. insulin, thereby decreasing the blood sugar levels
 - C. glucagon, thereby increasing the blood sugar levels
 - D. glucagon, thereby decreasing the blood sugar levels

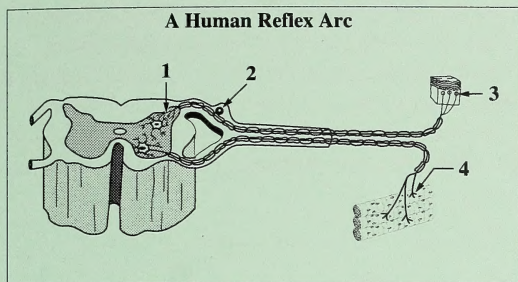
Students who achieved the standard of excellence, in addition to fulfilling the expectations identified above, interpreted interrelated sets of data presented in complex diagrams, tables, or graphs (questions 10, 24, 46, and 62). They analyzed multistep human physiological problems (questions 38, 39, 47–49, 63, and 65). They formed correct inferences from extracurricular data (questions 5, 11, 43, and 44). Most of these students recognized specialized parts of human structures and understood their functions (questions 17, 19, 58, and 70).

Detailed statistics and comments follow on five questions. Questions were chosen that measure achievement of those concepts in the current Biology course which relate to the general learner expectations of the revised Biology 30 curriculum.

Question 5 required students to analyze a scientific procedure and select processes that, if monitored, would support the hypothesis under investigation. Students had to recall that cells with mitochondria can carry out aerobic respiration, whereas cells without mitochondria can carry out anaerobic respiration. Energy (ATP), glucose, and oxygen (O₂) were identified in the context as variables involved in the process, but carbon dioxide (CO₂) was not identified. The majority of students who achieved less than 65% on the exam demonstrated inconsistent logic when relating contextual information to the descriptions of the possible experimental variables that could be measured. About one half of these students chose either alternative B or C, whereas only 10% of the students who achieved the standard of excellence on the exam chose either alternative B or C. The students who failed the exam simply guessed; they chose each of the four alternatives about equally. About 47% of the female population chose the keyed response in comparison to 65% of the male population.

Question 51 required students to recall the role of insulin and glucagon in blood sugar regulation. They then had to apply this knowledge to a common experience, eating a sugar-rich candy bar. Students had to understand that the ingested sugar would be absorbed into the blood causing an increase in the blood sugar level. This would then lead to a homeostatic response. Most of the students (85%) selected insulin as the hormone that would be secreted by the pancreas in response to the increase in blood sugar. Of these students, 10% predicted that the blood sugar level would increase (alternative A). Fifteen percent of the population chose glucagon as the hormone secreted by the pancreas. Of these students, 5% predicted that the blood sugar level would increase (alternative C).

Use the following information to answer question 59.



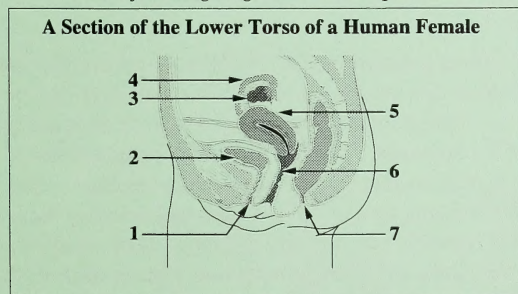
59. Jackie touched a hot stove with her hand and withdrew it automatically. In order for her cerebrum to also be activated by the same stimulus, an additional nerve pathway would have to be used. This pathway would branch off the reflex arc at the location labelled

- A. 1
- B. 2
- C. 3
- D. 4

69. It can be shown that surgical removal of the testes of a human male results in a marked increase in the pituitary secretions of both FSH and LH. Which concept about feedback control does this result support?

- A. LH and FSH secretion inhibits testosterone production.
- B. Testosterone inhibits pituitary secretion of LH and FSH.
- C. The absence of sperm prevents secretion of FSH and LH.
- D. The lack of secondary sexual characteristics stimulates secretion of FSH and LH.

Use the following diagram to answer question 70.



70. Which labelled structure has a unique characteristic not shared by any of the other labelled structures?

- A. Structure 1 opens to the external environment.
- B. Structure 2 has a wall containing smooth muscle.
- C. Structure 4 has a ciliated lining.
- D. Structure 5 is influenced by hormones produced elsewhere in the body.

Students who predicted that blood sugar level would increase perhaps inferred that the hormone increased sugar absorption from the gut. If so, they did not understand the sequence of cause and effect in the homeostatic control of blood sugar.

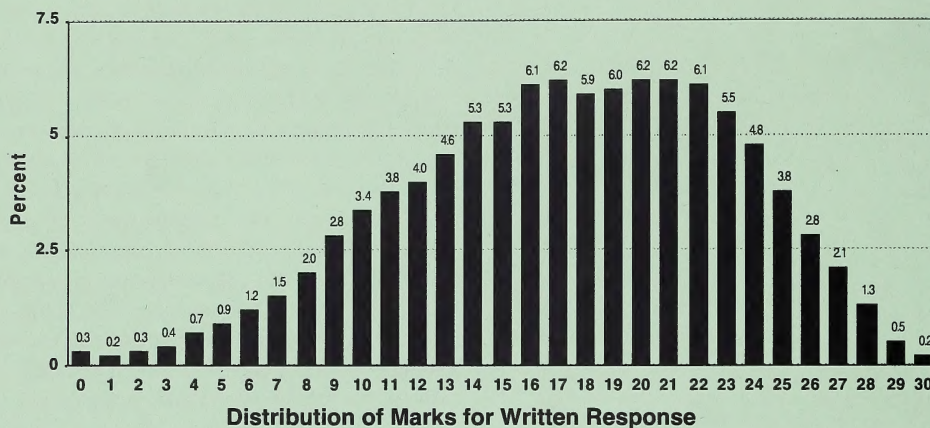
Question 59 required students to recall the components of a simple reflex arc as well as the relationship of the spinal cord to the cerebrum of the brain. Many students did not understand that all sensations that are transmitted to the brain from sensory receptors in the limbs and trunk of the body must be transmitted ultimately by nerve tracts that lie within the spinal cord. Therefore, these students thought that the nerve pathway could branch off peripheral structures. Twenty-eight percent of the population chose either alternative C or alternative D. A better understanding of the organization of the spinal cord (gray matter, synapses, interneurons) and its associated structures (dorsal and ventral roots, ganglia) would have eliminated alternative B, which was chosen by 22% of the students, including 14% of those who achieved the standard of excellence on the exam. About 46% of the female population chose the keyed response in comparison to 55% of the male population.

Question 69 required students to understand how the products of the testes provide negative feedback control of the pituitary gland. Students also had to understand the meaning of secondary sex characteristics and that the relationship between these characteristics and the function of the pituitary is indirect. Many students thought that males without testes would also lack secondary sex characteristics. They assumed that the pituitary gland would somehow become informed of this absence and therefore respond by secreting more hormones. Alternative D was chosen by 37% of those students who obtained a C on the exam and by 36% of those who obtained an F on the exam. Some students (12% chose alternative A) reversed the feedback relationship between testosterone and the pituitary hormones. About 47% of the female population chose the keyed response in comparison to 59% of the male population.

Question 70 required students to make structural and functional comparisons among female urogenital structures. Many students (21%) did not realize that almost all body organs are influenced by the endocrine system and therefore chose alternative D. Those students who chose alternative A (12%) should have observed that structures 6 (vagina) and 7 (anus) also open to the external environment. Most students recognized that structures other than structure 2 had muscular walls; only 8% of the population chose alternative B.

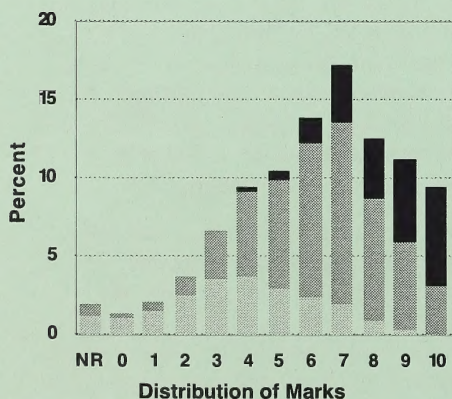
Teacher-Scored Section (Written-Response Questions)

The four questions in the written-response section required students to make connections between the concepts of human physiology and problems (hypothermia, reproductive technologies, blood-clotting, smoking) that many Albertans must resolve. They also had to understand the processes of science and relate these to a research study that was carried out at a Canadian university. The maximum value of any one written-response question is 10 marks. The four questions require students to use a variety of thinking skills, all of which go beyond, but are not isolated from, the ability to recall core concepts. Two of the four questions require students to relate technology to an understanding of science concepts.



Student responses to the teacher-scored section indicated that most students approached the examination seriously. All four questions were attempted by 91.9% of the students and very few (0.2%) did not attempt any of the four questions. A few students (0.2%) achieved full marks on each of the four questions. Approximately 68.9% of the students obtained 15 marks or more out of 30 on the teacher-scored section and 15.5% of the students obtained 24 marks or more. Most students presented answers that indicated they understood the problems to be addressed. Many students demonstrated creative and logical thought in making connections between physiological concepts and technological applications. A review of the distribution of scores on each written-response question revealed no significant gender differences.

Question 1



■ Standard of Excellence on the Examination
 ■ Acceptable but not Standard of Excellence on the Examination
 ■ Below Standard on the Examination

Question 1: A good proportion (74.7%) of the students addressed the major points of this question and therefore obtained 5 or more marks out of 10. Excellent answers (8 to 10 marks) were presented by 33.1% of the population. Student responses demonstrated a broad spectrum of knowledge and course-related content. Many students related the concepts of homeostasis and negative feedback to the effects of hypothermia on body systems. Many students also made appropriate links between systems; i.e., related the effects of hypothermia on the circulatory system to the nervous system. Some students did not provide sufficient linkage between cause and effect or they gave general effects rather than specific physiological effects. A common misconception was that cold temperatures disrupt enzyme structure.

Most students described technologies that could be used to induce hypothermia, but some students had difficulty explaining what would be gained by the procedure. Most students identified instruments that could be used to monitor induced hypothermia, but

some students did not describe adequately how the monitoring should be carried out; i.e., time interval.

Most students answered in paragraph form and used sentences that were well constructed. Most students used the information in the stem effectively to ensure that they addressed all parts of the question. Some students were excellent at pinpointing what the question required for an answer and therefore avoided presenting extraneous information. The correct use and spelling of biological terms was a problem for some students.

On this 10-mark question, the average mark was 6.19 or 62%.

Question 2: Student responses to this question demonstrated that about a third (36%) of the Biology 30 population are very knowledgeable (obtained 5 or 6 marks out of 6) about the function of the human reproductive system and related technologies. However, almost an equal number (32%) demonstrated a very poor understanding (obtained 2 or less marks out of 6) of both the human reproductive system and related technologies. This group includes a significant number (6.3% of total population) who chose not to answer the question. The reasons for not responding to an open-ended question on human reproduction are not evident. The students who answered the question did so in a neutral moral context.

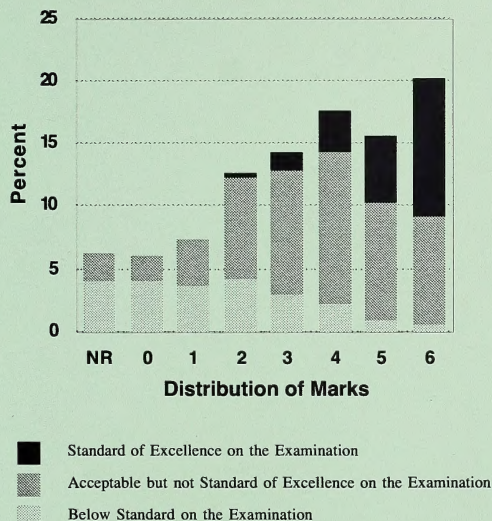
Those students who obtained 3 or 4 marks out of 6 frequently confused the roles of hormones (FSH and anabolic steroids) or provided technologies that did not correspond to the identified structure or function (function of testes linked to vasectomy). Many of these students also used terms incorrectly (vasectomy = cutting of Fallopian tubes). They gave general statements (birth control pills prevent pregnancy) that did not illustrate Biology 30 level of understanding.

On this 6-mark question, the average mark was 3.45 or 58%.

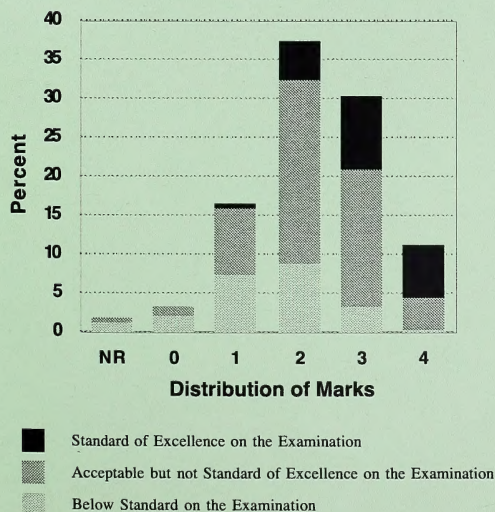
Question 3: This question required students to recall specific knowledge about the causes of strokes and heart attacks as well as the process of blood clotting. They had to understand the difference between the role of fibrin and fibrinogen in the clotting process. Students were expected to apply this knowledge to a new context (use of vampire bat anticoagulants) and explain the connections.

Most students who obtained only 1 mark for part *a* either explained that bat-PA dissolved blood clots that cause heart attacks and strokes or gave an advantage of bat-PA in contrast to human-PA.

Question 2



Question 3

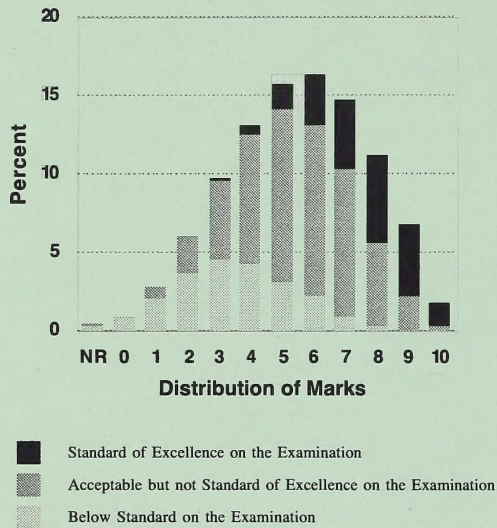


Those students who obtained 2 marks for part *a* usually did both. Almost all students answered part *b* correctly. Some students had misconceptions: i.e., bat-PA cleared clogged arteries of fatty materials, bat-PA “thins” blood, humans have more fibrin than fibrinogen, therefore bat-PA works better.

Most students (11%) who obtained 4 marks instead of 2 or 3 for their response to this question presented a specific description of where the blood clots form that cause heart attacks or strokes.

On this 4-mark question, the average mark was 2.26 or 57%.

Question 4



Question 4: This process skill question, which related to the health concerns of all Canadians, was attempted by almost all students (99.5%) who wrote the exam. The subparts of the question included a number of terms that describe the processes of science; i.e., hypothesis, manipulated variable, conclusion, support, interpret, valid. It was evident from student responses that these terms did not convey common and clearly defined meanings. Hypotheses were expressed in many different forms, very few in the “If ..., then...” format. The manipulated variable was confused with fixed variables; e.g., time on treadmill, number of subjects. Many students confused variables with groups; i.e., manipulated variable with experimental group. Some students did not link causes and effects when explaining differences in data. Conclusions were presented as restatements of specific data, rather than as generalizations supported by the data. Some students found it difficult to relate two sets of data (part *e*, Table 1 to Table 2).

In part *f* most students did not understand the unique social issues that arise when designing experiments with human subjects. Students focused on the range of differences that humans exhibit, but not on the problems of establishing experimental controls for subjects who have rights that arise out of freedom of choice.

For part *g* many students provided incomplete explanations. The science of the study was poorly used to justify the government action recommended.

One third of the population failed to achieve the acceptable standard on this question. This indicates that continued explicit attention must be given to the processes of science.

On this 10-mark question, the average mark was 5.45 or 55%.

For further information, contact Lowell Hackman or Phill Campbell at the Student Evaluation Branch, 403-427-0010.